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IS POLITICS POWER OR POLICY ORIENTED? A COMPARATIVE ANALYSIS OF DYNAMIC ACCESS MODELS IN POLICY NETWORKS*

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In policy networks actors use access relations to influence preferences of other actors. Establishment and shifts of access relations and their consequences for outcomes of decisions are the main focal points in this paper. Unlike most policy network studies, we therefore do not take the network and its relations as given and constant. Instead we device computer simulation models to account for the dynamics in policy networks. We compare different models and investigate the resulting network structures and predicted outcomes of decisions. The choice among the alternative models is made by their correspondence with empirical network structures and actual outcomes of decisions.

In our models, we assume that all relevant actors aim at policy outcomes as close as possible to their own preferences. Policy outcomes are determined by the preferences of the final decision makers at the moment of the vote. In general, only a small fraction of the actors takes part in the final vote. Most actors have therefore to rely on access relations for directly or indirectly shaping the preferences of the final decision makers. For this purpose actors make access requests to other actors. An access relation is assumed to be established if such a request is accepted by the other actor.

Access relations require time and resources. Actors are therefore assumed to be restricted in the number of access requests they can make and the number of requests they can accept. Moreover, due to incomplete information and simultaneous actions by other actors, actors have to make simplifying assumptions in the selection of their "best" requests and learn by experience.

We device two base models that correspond to two basic views on the nature of political processes. In the first view politics is seen as power driven. Corresponding to this view, actors aim at access relations with the most powerful actors in the field. They estimate their likelihood of success by comparing their own resources with those of the target actors. Power also determines the order in which actors accept requests. In the second view, policy matters and actors roughly estimate the effects access relations might have on the outcome of decisions. Actors select requests to "bolster" their own preference as much as possible.

We will show that these base models and some intermediate ones result in fundamentally different network structures and predicted outcomes. Moreover, we will show that the policy driven models do fundamentally better than the power driven models.

KEY WORDS: Policy networks, collective decision making, computer simulation, object-oriented modeling, dynamic modeling of social networks.

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1. INTRODUCTION

In a social system of at least some complexity collective decision making is necessarily connected with formal decision rules and procedures. They prescribe the steps to be taken in the decision making process and usually assign the final authority to vote, implement, and enforce decisions to a few actors. Stability in a social system and broad support for collective decisions require decision makers and a decision process that are broadly accepted as legitimate. In democratic societies this legitimation is often linked with elected final authorities and at least partial separation of power. Some political theorists like Schumpeter (1943) identify democratic decisions with democratically taken decisions. Other theorists, however, stress rightly that formally correct decision making is necessary but not sufficient for democratic decision making (Bachrach and Baratz, 1962; Lukes, 1974). They stress that content and quality of the decision itself are essential elements in the evaluation of the democratic character of decisions. In this line of reasoning, a decision has to be based on a "balanced" weighting of different interests in society. To arrive at such a balanced weighting, democracies assign the right of organization and manifestation to societal actors and often require consultations and hearings to promote their involvement. Particularly within this normative framework, we may expect that public authorities receive social recognition for properly weighting the intensity of interests and relative power of different societal actors into the decisions to be taken. Mistakes, particularly frequent mistakes, will result in heavy societal conflicts and failing implementation. This will have negative consequences for the likelihood of reelection of the public authorities themselves. Power of actors in social systems is, therefore, not solely based on (final) voting power, but also on the ability of actors to include their interests in decision outcomes. We denote the latter by *influence*. Influence is strongly determined by *access* to decision makers and *resources* to convince or enforce the inclusion of their interests in the outcome. The three essential power elements in collective decision making are therefore (final) voting power, timely access, and resources. Several resources are of importance. Information, in particular highly specialized information, is essential. Also quantities count, like the number of other actors that an actor represents, or economic resources, particularly if they are indispensable for the implementation of decisions.

Voting power, access, and resources determine the *potential power* of actors. Actual mobilization of power depends on three other elements. It depends on the *interest* of the actors in the decisions. The two other elements are their expectations on the *deviance of the outcome from their preference* and on the positive *effects* of participation (Zelditch and Ford, 1994; Stokman and Stokman, 1995). This implies that power becomes visible only if actors have diverging preferences on decision outcomes of sufficient interest to them. This phenomenon is captured in the literature under the name of nondecision making. It implies that models of collective decision making need to include not solely the three power elements. They also need to include the interest of the actors in the decisions and their preferences regarding decision outcomes. The *salience* of the decision for the actor denotes the interest of the actor in the decision, the *policy position* his preference.[1]

In the Seventies and Eighties several models for collective decision making have been published. Some of them are extensions of Coleman's exchange model of control (Coleman, 1972). In this model, actors have control over events and are interested in outcomes of events. Coleman shows how exchanges of control between actors result in changes at the collective level. Actors engage in exchanges if they have relatively more control over events in which they are less interested than in events that interest them intensely. The extensions aim to include preferences of actors in favor or against proposals. Other extensions connect Coleman's model to political networks (Marsden, 1981; 1983; Laumann, Knoke, and Kim, 1987; Coleman, 1990). Other models stem from political scientists who perceive politics as conflict resolution, fundamentally different from the exchange processes in economics on which Coleman based his exchange model. Very powerful is the model developed by Bueno de Mesquita (Bueno de Mesquita et al., 1985; Bueno de Mesquita and Lalman, 1986; Bueno de Mesquita, 1994). His model is based on three empirically estimated variables that characterize the relations between actors and each decision, namely their potential power, salience, and policy position. Actors evaluate the potential effect of challenges of each other's policy positions on the decision outcome. These challenges may result in enforced support of actors for other alternatives than they prefer and consequently in other outcomes of decisions. Stokman and Van Oosten (1994) model also support by actors for other alternatives than the preferred ones. In their model, this support is not due to enforcement but to exchanges of voting positions. One actor is willing to support the preferred position of another actor on one issue, if the other actor is willing to support his preferred position on the other. The extensions of Coleman's model are restricted to pro/con decisions. The latter models can predict outcomes as values on a continuum.

Common to all described models is their lack to represent explicitly all different power elements. The network models incorporate solely access relations in their models, neglecting differences in resources and voting power of actors. All other models use only one total score for the potential power of actors regarding each issue. This implies that the formal decision making process cannot be modeled properly in any of these models. This is particularly harmful because of the fundamental differences between voting and influencing (Mokken and Stokman, 1976). In the vote, voting power of actors counts, dependent on their weight in the vote and the voting rule. In the influence process, preferences are still evolving due to new information. The potential influence of actors now depend on their access to other actors and the available resources to convince other actors. Common to all models mentioned above, however, is the assumption that preferences of actors are given and constant. Actors are willing to exchange control, willing or forced to support other positions, but their preferences remain constant. The models completely neglect the preference formation process that is the core of the influence process. Studies on the management of meaning within organizations stress the importance of the latter (O'Reilly, 1983; Weick, 1979; Bouwen, 1993).

[1] Whenever we use the male form for an actor, we mean the female reference as well.

The Two-Stage Model of Stokman and Van den Bos (1992) includes both preference formation and explicit representation of voting and influencing as separate processes. They integrate the previous network models with models of voting power (Hoede and Bakker, 1982) and represent a political process as an iterative process of two stages.[2] In the influence stage, actors adapt their policy positions (preferences). They take into account policy positions of actors who have access to them. Their salience to the issue and resources determine the weight given to their position. After one or more influence rounds, actors with voting power take the final vote based on their preferences formed during the influence process. In this second stage, nothing else but the voting power of an actor determines his weight. The Two-Stage Model is, however, not more than a system of equations and fails to include a micro process in which actors optimize their decision making situation. Moreover, the Two-Stage Model shares with the other network models that its network of access relations is static and exogenous.

In the present paper, the main points of interest are the *establishment and shifts of access relations and their consequences for outcomes of decisions*. Unlike other policy network studies, we do not take the network and its access relations as given. In our models, *network formation* is connected with *preference formation* as the main characteristic of the influence process. After that, final voting takes place based on fixed preferences. We therefore explicitly represent influencing and voting as separate processes. Actors can influence each other's policy positions (preferences) only through access relations. Access relations are therefore instrumental to obtain policy outcomes as close as possible to the own preferences. Access relations arise when access requests are accepted by other actors. As the maintenance of access relations requires time and resources, we assume that actors can request and accept only a restricted number of access relations. Actors optimize access requests simultaneously. We will show that even for small social systems actors are unable to calculate effects of access relations on outcomes and to estimate their likelihood of success. We therefore assume that actors use simple heuristics and adapt their behavior by backward learning. These heuristics represent different views on politics.

The first view assumes that actors are primarily *power driven*. This view on politics has long been dominant in foreign policy making and international politics (among others Morgenthau, 1948; Kaplan, 1975; Waltz, 1979). It was also explicitly or implicitly adhered to by many scholars who studied national and local power structures. C. Wright Mills (1956) and Hunter (1953) are well-known representatives of them. Although this school of thought has partly waved away, we still find scholars who adhere to and build upon these ideas (for an overview: Knoke, 1990; Mizruchi and Galaskiewicz, 1993). Typically, they concentrate on power structures as their main object of study. They link very broad common interests to these power structures (see e.g. Domhoff, 1983). In accordance with this view, we elaborate the *Control Maximization Model* as the first base model. In this model, actors aim at access relations with the most powerful actors in the field. They estimate their likelihood of success by comparing their own resources with those of the target actors. Power also determines the order in which actors accept requests.

[2]Also later policy network models represent the formal process more explicitly (König, 1992; Kappelhoff, 1995).

The second view assumes that actors are primarily *policy driven*. Also this view has longstanding roots in international politics and foreign policy making (Allison, 1971) and political science (Dahl, 1961). In this view, analysis of power should be combined with an analysis of policy stands and the interactions between the two. Allison, for example, formulated his governmental (bureaucratic) politics paradigm by answering four interrelated questions:

> "Who plays? What determines each player's stand? What determines each player's relative influence? How does the game combine players' stands, influence, and moves to yield governmental decisions and actions?" (Allison, 1971, 164)

A combined analysis of power, communication, and policy stands revealed already soon the mechanisms and importance of selective exposure to information:

> "As others have before us, we, too, found that persons read and heard expositions of the views they already believed. Protectionists attended to protectionists, liberal traders to liberal traders." (Bauer et al., 1963, 467)

The combined focus on communication structures and issue stands crystallized into the concept of policy networks. The concept refers to the symbiotic relationship of state and society (Hanf and Scharpf, 1978; Heclo, 1978; Katzenstein, 1978). Policy networks typically refer to political problems involving complex political, economic and technical task and resource interdependencies (Knoke, 1990; Kenis and Schneider, 1991; Jansen and Schubert, 1995). The selective communication finding of Bauer et al. was corroborated in later and more detailed policy network studies (Heinz et al., 1993). Our second base model, *the Policy Maximization Model*, reflects this view and findings. Actors roughly estimate the effects access relations might have on the outcomes of decisions. Actors accept requests selectively to "bolster" their own preference as much as possible. Besides these two base models, we propose a few other models to investigate interaction effects between power and policy.

Modeling influence processes through access *requests* and *acceptance* seems to neglect a basic idea and finding in the literature on nondecision making. Actors often *anticipate* potential pressure from very powerful actors by taking their preference already into account in the formation of their own stand. Our models neither seem to include broadcasting and opinion formation via public media. If we take requests and acceptance literally, this is correct. We can define access relations, resulting from requests and acceptance, also more broadly as indication that the preferences of such actors are considered. An access request indicates then not only an actual but also an intended request if one's own preference would not be taken into account. Acceptence simply indicates that the preference of the other is actually taken into account. In this broader sense, our model includes also anticipation and (selective) exposure to media. This corresponds with the indicator we normally use in our studies. It phrases access as weighting the other's preference in one's own.

2. BASIC DEFINITIONS

Starting point of our models is an *issue domain* consisting of a set of n actors $(i, j, k = 1, \ldots, n)$ and a set of m issues or decisions $(a, b, c = 1, \ldots, m)$. Among other things, decision making procedures determine which actors take the final decisions.

The voting rule and the weight of an actor in the final vote determine his *voting power*. In our models, we assume that decisions are made in a given decision making procedure. Consequently, voting power is not time dependent. The voting power of actor i on issue a is denoted v_{ia}. If $v_{ia} > 0$, actor i is a public actor. All other actors are private actors. Generally, only few actors are endowed with voting power. For each issue a:

$$\sum_{i=1}^{n} v_{ia} = 1, \qquad v_{ia} \geq 0; \quad a \in 1 \ldots m.$$

Actors have a preference regarding the outcomes of the decisions. The preferred outcome of a decision for an actor is called his *policy position*. Before the final vote, public and private actors try to influence each others policy positions aiming at decision outcomes close to their own policy positions. Policy positions are therefore time dependent. The policy position of actor i on decision a at time t is denoted x_{ia}^{t}.

Actors have different capabilities to influence each other in the stage before the final vote. The capability of an actor depends on his *access* to other important actors and the *resources* he can mobilize in these relations. The resources actor i can mobilize in the influence stage are denoted r_i ($r_i \leq 1$). Although the relevance of resources depends on the issue domain under investigation, important resources generally include (exclusive) information and financial resources. Resources often result from longterm investments. For that reason, resources of actors are presently not seen as time dependent. Access relations seem to be more flexible than power resources. This is reflected in the considerably higher difficulties to get reliable empirical data on access relations than on power resources in ongoing empirical network studies. Access relations, therefore, are time dependent in our models. If actor i has access to actor j at time t, $a_{ij}^{t} = 1$. If not, $a_{ij}^{t} = 0$. It is assumed that actor i has full access to himself ($a_{ii}^{t} = 1$). All access relations in an issue domain are contained in the adjacency matrix A^t.

The interest of actor i in decision a determines his willingness to mobilize his resources in the influence stage. It is denoted by the *salience* of decision a for actor i (s_{ia}). Over the set of issues, for each actor i holds:

$$\sum_{a=1}^{m} s_{ia} \leq 1, \qquad s_{ia} \geq 0; \quad i \in 1 \ldots n.$$

Actors, decisions, voting power, initial policy positions, saliences, and resources are exogenous elements in our models. Voting power usually is determined by investigation of the formal decision making procedures. Stokman and Van den Bos (1992) propose a measure of voting power that can also be applied in multi-level voting procedures (like parliaments with several chambers). The other elements are usually obtained either by interviewing experts or representatives of the actors involved in the issue domain. For this purpose special interview techniques have been developed (see Bueno de Mesquita and Stokman, 1994).

Access relations among actors are generated as endogenous elements in the model. In the present versions of the models, the actors start from scratch when attempting to establish access relations. No access relations exist at $t = 0$.[3] Establishment and shifts of access relations and their consequences for outcomes of decisions are the main focal points in our models.

3. AN EXAMPLE

We illustrate the dynamic access models with a small empirical example, namely *the financial restructuring of a large Dutch company* (AVEBE). The issue domain consists of eighteen actors and three decisions. The AVEBE is a cooperative company of farmers in the northern part of the Netherlands that produces derivatives of potatoes. The company, already in financial problems since the mid-Sixties, came in serious financial problems in the mid-Eighties. Its survival was of very high importance for the northern part of the Netherlands. It employed not only a large number of people, but its financial bankruptcy would have serious financial consequences for the farmers because of their unlimited liability in the cooperative firm. Three main issues were at stake. The company's own capital was almost completely lost and had to be restored. Moreover, its survival required a considerable reduction of its debt. Finally, the company was seriously polluting the environment and high investments had to be made to adapt the pollution to the more stringent norms of the Dutch government. In January 1986, the company asked the Dutch government to reduce its debt with Dfl 200 million by an interest-free and redemption-free loan. Moreover, it asked for a financial arrangement for environmental investments of Dfl 80 million. Such matters are delegated to an Advisory Committee for Financial Restructuring, denoted the Committee Goudswaard (the name of its chairman). In actual practice, this Committee has the ultimate power to decide on the matter. The Committee came with its advise in the Summer of 1986.

In our model, the Committee Goudswaard was given full voting power as it was *de facto* the final decision making body. The other data were obtained by interviewing two experts. These data concern the actors with their resources and mutual access relations, and the policy positions and saliences of the actors regarding the three issues. The two experts generated the same list of actors with only one exception. They agreed to a very large extent on all variables to be used in our models. We therefore use the mean values of the two experts on the variables (see Table 1 and 2). Clear differences in reports were obtained only in the access networks. However, these network data will not be used. We will use their network data only to compare them with the networks generated by our simulation models. As the two experts had complementary expertises (one had expertise at the national, the other at the regional level), their access data were combined. This means that we assume an access relation between two actors to exist in the empirical network if at least one of the experts reported such a relation.

[3] We could well have started from a network in which the institutionalized access relations were given. Presently, we are interested to investigate of whether our models are able to reproduce empirical influence networks and to predict correct outcomes even without such an initial network. We think it certainly is worthwhile to investigate the effects of initial institutional access relations on network structures and outcomes in future research.

TABLE 1
Actors and Resources AVEBE Policy Domain

Actors	Resources	Voting Power
Executive Board AVEBE	0.18	0
Supervisory Board AVEBE	0.18	0
Farmers	0.20	0
Farmers Workgroup Veenkolonien	0.04	0
Regional Trade Union	0.04	0
Board of Employees AVEBE	0.06	0
Farmers Bank RABO	0.76	0
National Investment Bank	0.24	0
Province Groningen	0.10	0
Ministry of Agriculture	0.34	0
Ministry of Economic Affairs	0.12	0
Ministry of Finance	0.12	0
Ministry of Environment	0.18	0
Second Chamber Cie Agriculture	0.08	0
Second Chamber	0.08	0
Committee Goudswaard	0.60	1
Political Party CDA	1.00	0
Green Movement	0.80	0

When model elements are introduced, we illustrate them with a simulation on the third issue, the environmental investments. In this simulation we delete the two actors with unknown policy positions on the issue. We illustrate the unfolding of the access networks with a simulation on all three issues simultaneously. Replicated simulation results over all decisions are reported in Section 6.

4. BASIC ASSUMPTIONS ON THE ISSUE DOMAIN

Before we can develop a tractable model of the establishment and shifts of access relations, we need a number of simplifying *assumptions* on the issue domain.

First, we assume *unidimensional issues*. In other words, the policy positions of the actors on an issue can be represented as points on a one-dimensional continuum.

The second assumption specifies the class of utility functions of the actors on the issue dimensions. On each issue a, actors have *single-peaked preference functions*. The utility of a certain point on issue a (x_a) for actor i is a function of the interest of the actor in the issue, s_{ia}, and the distance between that point and the policy position of actor i on decision a at time t:[4]

$$U^i x_a^t := -s_{ia}|x_a - x_{ia}^t|^q, \qquad q > 0. \tag{1}$$

Throughout this article we assume $q = 1$.[5]

[4]In our models we use in fact a utility loss function. Equation (1) gives the utility loss of each point relative to the preferred position of the actor. Moreover, positions on issues can have very different ranges. For that reason, all issues are normalized between 0 and 1 by subtracting the minimal policy position and by dividing the policy positions of actors through the range of all position values. The utility function is therefore defined on the normalized position values.

[5]With $q = 1$, we specify a linearly decreasing utility function. The larger q, the larger the utility loss at larger distances. With more issues involved, utility loss is then primarily determined by the issue with a large distance between the preferred position and the outcome. In some models, like the conflict model of Bueno de Mesquita, q is not equal for all actors. Actors with $q < 1$ are 'risk-taking', actors with $q > 1$ are 'risk-averse'.

TABLE 2
Policy Positions and Saliences in AVEBE Policy Domain

	Policy Position			Salience		
Actors	Own Capital[a]	Reduction Debt[b]	Investment Environm.[b]	Own Capital	Reduction Debt	Investment Environm.
Executive Board AVEBE	30	200	71.25	0.36	0.38	0.25
Supervisory Board AVEBE	30	200	71.25	0.36	0.38	0.24
Farmers	10	300	37.5	0.24	0.40	0.32
Farmers Workgroup Veenkolonien	20	700	75	0.32	0.36	0.12
Regional Trade Union	40	200	75	0.32	0.36	0.14
Employees AVEBE	27.5	175	56.25	0.36	0.30	0.22
Farmers Bank RABO	35	175	unknown	0.30	0.24	0.12
National Investment Bank	35	175	unknown	0.06	0.12	0.12
Province Groningen	20	250	95	0.20	0.26	0.30
Ministry of Agriculture	35	150	78.125	0.28	0.26	0.14
Ministry of Economic Affairs	35	150	65.625	0.20	0.18	0.14
Ministry of Finance	35	150	65.625	0.20	0.18	0.14
Ministry of Environment	35	150	95	0.20	0.18	0.24
Second Chamber Cie Agriculture	30	150	56.2	0.32	0.32	0.24
Second Chamber	30	150	56.2	0.32	0.32	0.24
Committee Goudswaard	35	150	65.63	0.16	0.18	0.12
Pol Party CDA	40	200	75	0.16	0.20	0.12
Green Movement	nil	nil	110	0.32	0	0.40

[a]Percentage of whole capital.
[b]Million Dfl.

The total utility over all m issues for actor i is assumed to be the sum of his utilities over all issues (cf. Baron, 1991):

$$U^i x^t := \sum_{a=1}^{m} U^i x_a^t. \tag{2}$$

In particular we are interested in the utility of the expected outcomes of decisions for actor i. The third assumption concerns the *expected outcome* of a decision. The expected outcome of decision a at time t (O_a^t), is assumed to be the mean policy position of the public actors, weighted by their voting power:

$$O_a^t := \sum_{i=1}^{n} x_{ia}^t v_{ia}. \tag{3}$$

In the example of the AVEBE, the sole actor with voting power is the Committee Goudswaard (see Table 1). The initial predicted outcome on environmental investments is therefore MDfl 65.63 (see Table 2). The utility of this initial outcome for the political party CDA is:

$$U^{\mathrm{CDA}} O_{\mathrm{env}}^0 = -0.12^*(|65.63 - 75|/72.5) = -0.016.$$

72.5 is the normalization factor (the distance between the highest and lowest policy position on the issue).

The assumptions of unidimensionality of the issues and of single-peaked preference functions point in the direction of the median voter theorem of Black (Luce and Raiffa, 1957). Black demonstrated that, under the rule of simple majority, the median voter takes the winning position, because that alternative defeats all other alternatives in head to head competition (the Condorcet winner). The median voter theorem takes only the ordering of the policy positions of the actors into account, not the interval information of the policy scale. However, as the utility functions in the third assumption are defined in terms of interval scales, it is justified to take the interval scale information also into account and to define the decision rule in terms of the mean position of the actors instead of the median position. It has the additional advantage that the expected outcome is defined as a continuous variable and not as a discrete variable.[6]

Stokman and Van den Bos (1992) argue that public actors aim at balanced decisions in which policy positions and interests of significant actors are taken into account. It would give public actors social recognition in the issue domain. This makes the properly weighting of positions an important instrumental goal for actors in an issue domain. Referring to Poulantzas (1978, 132–135), Quadagno formulated it as follows:

> "The state, then, is not a unified mechanism founded on a hierarchical distribution of power, but rather a mediating body that weights priorities, filters information given and, because of its autonomy from any given class or faction, integrates contradictory measures into state policy." (Quadagno, 1984, 634)

The fourth assumption concerns the *potential control*[7] of an actor over another actor in the influence stage. We assume that it depends on the relative size of the actor's own resources over those of the target actor and of the other actors with access to the target actor at time t:

$$c_{ij}^t := \frac{r_i a_{ij}^t}{\sum_{k=1}^{n} r_k a_{kj}^t}. \tag{4}$$

If we would assume that at time 1 only CDA and Farmers would have access to the Committee Goudswaard, the controls of CDA and Farmers over the Committee Goudswaard would be:

$$c_{\mathrm{CDA,Goudswaard}}^1 = 1/(1 + 0.20 + 0.60) = 0.56$$

and

$$c_{\mathrm{Farmers,Goudswaard}}^1 = 0.20/(1 + 0.20 + 0.60) = 0.11$$

respectively.

The remaining control of the Committee over its own policy position is:

$$c_{\mathrm{Goudswaard,Goudswaard}}^1 = 0.60/(1 + 0.20 + 0.60) = 0.34.$$

Note that the total of incoming control is one.

The control relations determine the abilities of actors to induce changes in policy positions of other actors if they deviate from an actor's own policy position, while the salience of the decision determines the willingness of an actor to put such abilities into effect. If we assume that the influence processes take place simultaneously, the policy position of an actor at time $(t + 1)$ can be seen as a weighted sum of his own policy position and that of other actors at time t. The weights are determined by his own and incoming control at time t, as defined in Equation (4), and the saliences of the decisions for the actors. This brings us to the fifth assumption regarding the *development of policy positions* of actors over time:

$$x_{ia}^{(t+1)} := \frac{\sum_{j=1}^{n} x_{ja}^t c_{ji}^t s_{ja}}{\sum_{j=1}^{n} c_{ji}^t s_{ja}}. \tag{5}$$

Under the assumption of access relations from only CDA and Farmers to the Committee Goudswaard at time 1, the policy position of the Committee Goudswaard on environmental investments at time 1 would become:

$$x_{\mathrm{Goudswaard,env}}^1 = \frac{(75^*0.16^*0.56 + 37.5^*0.24^*0.11 + 65.63^*0.16^*0.34)}{(0.16^*0.56 + 0.24^*0.11 + 0.16^*0.34)}$$

$$= 11.28/0.1704 = 66.20.$$

As Equation (5) shows, the policy positions of all actors are changed in the influence stage prior to the vote. These changes are independent of the voting powers of actors over decisions. The latter, however, transform the shaped positions of public actors into outcomes of the decisions in the voting stage of the decision making process (see Equation 3).

[6]When the model predicts the outcomes of decisions correctly, the model can be used to estimate the overall power of actors in the issue domain and the values of the decisions. As these aspects are less relevant for our discussion, the reader is referred to Stokman and Van den Bos (1992) for these aspects of the model.

[7]Actually we would have preferred to speak about *potential influence* of an actor, but the matrix of potential influence relations is often denoted *control matrix* in the literature on social networks. We decided to follow that tradition.

5. DYNAMIC ACCESS MODELS IN POLICY NETWORKS

Within an issue domain, the ultimate goal of actors is assumed to be the attainment of policy outcomes that are as close as possible to their own policy positions. These outcomes are determined by the public actors with voting power over the decisions. However, these public actors, like other actors, shape their own policy positions in the influence stage. The sole means by which relevant private actors are able to realize a more favorable outcome of a decision consists of trying to shift the policy positions of public actors. In the influence stage, optimal shaping of policy positions of other actors can therefore be seen as an important intermediate goal of actors. Success depends on whether the actor has timely access to other actors, and on his ability to mobilize important resources to shape the policy positions of these others. As such, the appropriate model in this stage is more akin to a *marketing* model than to an exchange model. Such a marketing model can be formulated as the problem of how an actor can optimize his access relations towards other actors.

Access relations are established in two consecutive steps. In the first step, actors evaluate alternative access requests. Since access requests and access relations require time and resources, actors are able to make only a limited number of access requests to other actors. The choice depends on the utility of the request and the likelihood it will be accepted. Because of limited information, actors can make only rough estimates for both. In the next step, actors evaluate the access requests they received. If the number of requests is larger than they can handle, they accept only some of them. We assume that actors learn through experience. Successes or failures of previous access requests are used to adapt their estimate of the likelihood of acceptance of new requests. In Section 5.1, we shall first state the restrictions the actors are confronted with. In Section 5.2, we will show that a full information model makes no sense as it involves very complicated calculations for the actors. Alternative limited information access models are subsequently elaborated in Section 5.3.

5.1. Restrictions with Respect to Access Relations

Establishment and effectuation of access relationships require time and other resources. Consequently, we assume that the maximum number of access relations an actor can deal with depends on his resources. Also, incoming influence requires the allocation of time and other resources to these activities. If actors were solely oriented towards advancing their own policy positions, they would spend all their time and resources to outgoing access relations, and refuse incoming influence. If all actors in an issue domain would act so, no influence would be realized at all. What, then, determines whether or not an actor will accept an incoming access request? Incoming relations are important for an actor, because they provide him with information on the relevant actors in the policy network, and in this manner help him to shape his own policy position. Moreover, an actor's claim that his policy position is based on information provided by many other relevant actors, contributes to his influence on the other actors. In other words, incoming relations contribute to an actor's resources. Next, in any society, but particularly in a democratic society, it is a drawback for a powerful actor to be seen to be unwilling to accept influence from other actors. Finally, actors often seek information (and consequently accept influence) from different actors than they themselves try to influence. For example, in preparing an interview with a member of parliament, an actor may consult different experts to ground his preferred positions on sound arguments. We incorporate these mechanisms into our model by applying the principle of *generalized reciprocity*. This principle is well known in personal network theory (Alexander, 1987; Boyd and Richerson, 1989). It is employed to explain why certain social exchange relations in personal networks remain asymmetrical, instead of becoming more reciprocal. In a social system, these asymmetrical relations are tolerated as long as an actor is willing to help another actor in case the latter needs it. The same principle of generalized reciprocity can be found in the field of international economics when import and export relations are considered. Imbalances between import and export quota between two individual countries are tolerated as long as the balance of payments for each country is in equilibrium. Translated to issue domains, the generalized reciprocity principle implies that *outgoing control or voting power should be balanced by incoming control*. As an example, the White House is allowed to have large control over other actors and to have much voting power if and only if it has an open eye for other societal actors, balancing their interests, policy positions, and power resources.

The above considerations result in the following propositions on the *maximal number of access requests an actor is allowed to make and has to accept*. Let us denote the number of outgoing relations of actor i at time t od_i^t and the number of incoming relations id_i^t. The maximal number of access requests an actor is allowed to make at time $(t+1)$, $(od_i^{(t+1)})_{\max}$, is a function of the resources of an actor and the number of incoming relations at time t. The larger the resources of an actor, the higher his voting power over the issues, and the more outgoing relations at time t, the more access requests an actor has to accept at time $(t+1)$ $((id_i^{(t+1)})_{\max})$. The following functions were specified for the simulations in this article:[8]

$$(od_i^{(t+1)})_{\max} = [0.5nr_i + 0.5id_i^t] \tag{6}$$

and

$$(id_i^{(t+1)})_{\max} = \left[0.25\left(nr_i + n\sum_{a=1}^{m} v_{ia} \Big/ \left(\sum_{a=1}^{m} v_{ia}\right)_{\max}\right) + 0.5od_i^t\right]. \tag{7}$$

If we consider the AVEBE issue of the environmental investments, the initial maximal number of access requests the Committee Goudswaard is allowed to make at time 1 is:

$$(od^{(1)}_{\text{Goudswaard}})_{\max} = [0.5*16*0.60] = [4.8] = 5.$$

The maximal number of requests the Committee has to accept at time 1 is:

$$(id^{(1)}_{\text{Goudswaard}})_{\max} = [0.25(16*0.60 + 16*1)] = [6.4] = 6.$$

During the network evolution these numbers will gradually increase because of the realized access relations to and from the Committee Goudswaard.

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[8]The symbol [ ] denotes the value rounded on its nearest integer.

5.2. Utility of Access Relations Under Full Information

Success of various access relations can be evaluated on the basis of the likelihood and the size of favorable changes in decision outcomes. This implies that the expected utility of an access relation of actor i to actor j $(EU^i a^t_{ij})$ will ultimately be evaluated by actor i on the basis of its expected positive consequence on decision outcomes due to changing positions of actor j. We denote the utility of such an overall shift in decision outcomes for actor i as induced by changes in policy positions of actor j $U^i \Delta^+ O^t_j$. Consequently:

$$U^i a^t_{ij} := U^i \Delta^+ O^t_j = \sum_{a=1}^{m} \Delta^+ O^t_{ja} s_{ia}, \tag{8}$$

in which $\Delta^+ O^t_{ja}$ is the positive shift for actor i in the outcome on issue a due to actor j's shift in policy position.

Let us denote the shift in policy position on issue a of actor j as effectuated (induced) by actor i: $\Delta^+ x^{(t)i}_{ja}$. If actor j has voting power, a shift in policy position of actor j on issue a will result in a direct shift of outcome of $\Delta^+ x^{(t)i}_{ja} v_{ja}$. A shift in policy positions of actor j can also have an indirect effect on policy outcomes if actor j has control over one or more actors with voting power. The total effect of a shift of policy position of actor j on the outcome of issue a thus becomes:

$$\Delta^+ x^{(t)i}_{ja} \left(\sum_{k=1}^{n} c^t_{jk} v_{ka} + v_{ja} \right) = \Delta^+ O^t_{ja}.$$

The utility for actor i of an access relation to actor j can now be specified as follows:

$$U^i a^t_{ij} = \sum_{a=1}^{m} \left(\Delta^+ x^{(t)i}_{ja} \left(\sum_{k=1}^{n} c^t_{jk} v_{ka} + v_{ja} \right) s_{ia} \right). \tag{9}$$

The evaluation of this function would require an enormous amount of information and calculation by each actor. For example, each actor would need to know all incoming and outgoing access relations of each other actor j. Even if an actor would be able to properly evaluate this function, he still would not know whether the effect of his efforts in the end would be as intended. Due to successfull access requests of other actors, who are optimizing their access relations at the same time, other access relations in the network continously change. Accordingly, we assume that actors do not evaluate access relations on the basis of such an elaborate calculation of the (expected) utility of these relations, but on the basis of simpler notions about the subgoals to be met.

5.3. Alternative Models Under Partial Information

First, we specify the information actors are assumed to possess about an issue domain. Since institutional arrangements belong to the public domain, we assume that actors have full information on the distribution of voting power over the actors in the issue domain. Moreover, we assume that actors are able to estimate the policy positions, saliences, and resources of all actors in the domain. With respect to the control network, we assume that an actor is unable to observe the precise control relationships from and to actors. They are able, however, to estimate the total amount of control by and on each actor in the issue domain.

We formulate two base models that reflect the two opposite views in politics introduced in Section 1. The first model reflects the view that politics is power oriented and consequently that the main aim of access is the creation of a power base. This model is denoted the *Control Maximization Model* (CMM). The second model reflects the view that politics is policy driven. The main aim of actors is now the realization of outcomes of decisions close to their own preferences. For that purpose they aim at access to actors with opposing views, but are primarily open for influence from likeminded actors. This model is denoted the *Policy Maximization Model* (PMM). From these two base models we formulate two other substantively interesting models in which we assume interactions between power and policy. One of these interaction models lies in between the two base models, the other is even more policy oriented than the PMM.

Three main elements have to be specified for alternative models under partial information. First, actors have to approximate the utility of alternative access requests under the partial information they have. Second, actors need to estimate the likelihood of success of alternative requests. The product of the two determines the *expected utility* of alternative access requests and the order in which actors will make these requests. The third element concerns the order in which actors accept access requests. The two base models differ from one another in all three elements. The two additional interaction models are obtained by the introduction of interaction terms in the order of acceptance of access requests by actors. This implies that we use two alternative specifications for the extending of access requests, two for the estimation of the likelihood of success and four for the acceptance of access requests. This results in sixteen possible models ($2 \times 2 \times 4$). Although not all of these models are substantively meaningful, we compare their results in Section 6 to investigate the main and interaction effects of all three model elements.

5.3.1. The Control and Policy Specification for Access Requests

On the basis of his partial information, each actor is able to compute the expected outcomes of the decisions at the different points in time. However, actors are unable to calculate both the effects of access relations on shifts in policy positions by target actors and their subsequent effects on the decisions taken. An actor i does not know who else is exerting control on actor j, let alone in which direction they try to move actor j. Moreover, he does not know the identity of the actors who are under the control of actor j. He is therefore not able to estimate the final effect of a successful access relation on the policy positions of actors with voting power. He only knows the total amount of control actor j is able to exercise in the issue domain.

Since the actors in the issue domain know how much control and voting power each of them has, actors may decide to optimize their control over powerful actors in the issue domain. This requires that the actor is also able to estimate how much

FIGURE 1. Expected outcome (O_a) and policy positions of three actors on decision a.

control he would be able to exert on other actors. Under the assumption that other access relations do not change, actor i is indeed able to estimate his control over actor j. It is equal to his own resources divided by the total amount of resources that is effective on actor j (i.e. the resources of actor j and the resources of all actors with access relations to j). This choice mechanism will be defined as the *Control Request specification* (CR). The approximation of the utility of the different access relations under this specification is equal to:

$$U^{*i}a_{ij}^t := \hat{c}_{ij}^t\left(c_{j\bullet}^t + \sum_{a=1}^{m}(v_{ja}s_{ia})\right), \tag{9a}$$

in which $\hat{c}_{ij}^t$ is i's estimate of c_{ij} and

$$c_{j\bullet}^t := \sum_{k=1}^{n} c_{jk}^t.$$

Note that actors do not at all take the policy positions of other actors into account.

We again consider the AVEBE issue on environmental investments. At time $t = 0$, no access relations exists. Consequently, none of the actors has outgoing control to or incoming control from other actors. The sole actor with positive power is the Committee Goudswaard as it has voting power. At time $t = 1$, only access requests to the Committee Goudswaard have positive utility in the eyes of all other actors. At time $t = 1$, all actors will therefore only make an access request towards the Committee Goudswaard, not to other actors. The estimated utility of the request for the Farmers is:

$$U^{*\text{Farmers}}a^0_{\text{Farmers,Goudswaard}} = 0.20/(0.20 + 0.60)^*1^*0.32 = 0.08.$$

As none of the other actors has voting power or indirect influence through access relations, the Committee Goudswaard will make no requests although it is allowed to make five.

In the *Policy Request specification* (PR), actors use their knowledge on the policy positions of other actors and the expected outcome of the decision. In this more sophisticated specification, actors still focus their efforts on the actors who have great control and voting power in the issue domain. However, they also consider in which direction the policy position of the target actor will possibly move as a result of an established access relationship. This factor determines whether a subsequent shift in the expected outcome will have positive or negative consequences for the actor. This is illustrated in Figure 1. We assume that actor i wants to optimize his access relations at time t, and that actor j has a more extreme policy position than actor i on the same side of the expected outcome. An access relation from i to j would result in a less extreme position of actor j at time $(t + 1)$, and would result in a shift of the expected outcome of the decision in the wrong direction (away from the policy position of actor i). Consider instead a successful access relation of actor i to actor k. Such an access relation would result in a shift by actor k in the direction

of the policy position of actor i, and, consequently, to an expected outcome closer to actor i's policy position. *Thus, in general, influence on actors with a more extreme policy position on their own side of the expected outcome is counterproductive.* Access relations to other actors with exactly the same policy positions have no direct effect (at most it can outbalance effects of other actors). In all other cases, an access relation has a potentially positive effect. This effect will be larger, the larger the distance between the policy positions of the two actors. If more issues are involved, access relations gain importance if they effect outcomes of decisions on which the distance between the expected outcome and the policy position of the actor is large. Moreover, the utility gain is higher for more salient issues. These considerations are incorporated in the model by including the following factor into the utility function:

$$\sum_{a=1}^{m} s_{ia}(x_{ia}^t - O_a^t)(x_{ia}^t - x_{ja}^t).$$

The larger the product, the more positive the impact of the access relation. The approximation of the utility of the different access relations under the *PR specification* can now be given by the following equation:

$$U^{**i}a_{ij}^t := \hat{c}_{ij}^t\sum_{a=1}^{m}[s_{ia}(x_{ia}^t - O_a^t)(x_{ia}^t - x_{ja}^t)(c_{j\bullet}^t + v_{ja})]. \tag{9b}$$

In the example of the AVEBE, the policy position of the Committee Goudswaard will be equal to the expected outcome on all issues. Under Equation (9b), the Committee Goudswaard would have no incentives to make any access requests at all. We therefore make a different PR specification for actors who have the same policy position as the expected outcome on all issues. For these actors, we assume that the utility of access relations increases according to the additional support they provide for the expected outcome. Consequently, these actors attempt to get access to extreme actors to moderate their preferences. This is realized by replacing the term $(x_{ia}^t - O_a^t)(x_{ia}^t - x_{ja}^t)$ in Equation (9b) by $|x_{ia}^t - x_{ja}^t|$.

In the example of the access request of the Farmers to the Committee Goudswaard, the estimated utility under the *PM* model is:

$$U^{**\text{Farmers}}a^0_{\text{Farmers,Goudswaard}} = 0.20/(0.20 + 0.60)^*0.32^* - 28.13/72.5^* - 28.13/72.5^*1 = 0.012.$$

The choice of access requests does not only depend on the utilities, but also on the likelihood of success. This likelihood of success depends on the order in which actors accept access requests. For that reason we first consider the alternative specifications for the acceptance of access requests before we deal with alternative specifications for the estimation of the likelihood of success.

5.3.2. Four Specifications for Access Acceptance

If an actor receives more requests for incoming access relations than he is allowed to accept, he has to decide which requests to accept and which to refuse.

In the *Control Acceptance specification* (CA), actors have to accept requests in the order of the resources of the proposing actors. If a choice has to be made between actors with equal resources, a random choice is made. Under this specification, the choice between incoming access requests is independent of the policy positions of actors. In the example of the White House, the White House cannot refuse incoming influence from powerful actors with the argument that there are already so many incoming influences from powerless actors.

In the *Policy Acceptance specification* (PA), on the contrary, the order of acceptance depends on the proximity of the policy positions of the other actors and is completely independent of the resources of the actors. The reader should realize, however, that an issue domain only consists of actors with positive resources. Within this boundary, however, the only thing that counts is distance. The larger the distance between the policy positions of actors, the more reluctant they will be to accept influence from one another. For example, an extreme left wing actor might gain a lot by influencing an extreme right wing actor. Most of the time, however, the right wing actor will not be receptive to extreme left wing influence, particularly not, if it concerns issues that are highly salient to the right wing actor. Moreover, we assume that close distances matter more than large ones. In other words, actors care more about differences in preferences among actors they feel similar to. Different preferences between distant actors matter less. As such, each actor i orders the incoming access requests according to the following:

$$\sum_{a=1}^{m} s_{ia}\left(1-\sqrt{|x_{ia}-x_{ja}|}\right).$$

This acceptance rule of access requests makes actors as immune as possible against changes in their own policy positions. While trying to influence distant actors, they try to uphold their own policy position by giving priority to influence from likeminded actors. Only if these are not present in the issue domain or make no access requests to them, they are forced to adapt their own preferences. Also, this acceptance rule incorporates the frequent conclusion that decision makers engage in "bolstering", giving too much attention to sources that share the decision maker's own predispositions (Calvert, 1985). We can even state that the rule explains "bolstering" as rational behavior to prevent the expected outcome from shifting in the wrong direction. Moreover, this acceptance rule reflects the finding from many policy network studies that political actors interact primarily with others who share their policy preferences (Bauer et al., 1963; Heinz et al., 1993) and that heavy conflicts often arise among actors about slight differences of opinion.

Two other specifications are proposed in which both resources and distance of policy positions are relevant. The first one assumes that actors prefer requests from likeminded actor, but cannot completely neglect the power of the actors. The order of acceptance for actor i is therefore based on the interaction of the two:

$$r_j \sum_{a=1}^{m} s_{ia}\left(1-\sqrt{|x_{ia}-x_{ja}|}\right).$$

We denote this specification the *Control/Policy Acceptance specification* (CPA). It lies in between the two base specifications for accepting access requests.

Under the second interaction specification, the "bolstering" effect is even more emphasized than under the PA specification. Actors select access requests of the most powerful actors if their policy positions are close to their own policy position. If the difference between their own and the other's position is larger than a certain threshold, they select the *least* powerful actors. Beyond the threshold, actors thus try to minimize the influence they are subject to. Such access relations have a more or less symbolic meaning. They demonstrate that the actor is open for broader influence but at the same time he tries to minimize that influence. Even more than under the PA specification, actors select access requests in such a way that they can maximally uphold their own policy position while trying to influence actors with quite different policy positions. For that reason, we call this interaction specification the *Policy/Legitimation Acceptance specification* (PLA for short). If we denote the threshold for actor i by h_i, the order of acceptance for actor i is given by:

$$r_j \sum_{a=1}^{m} s_{ia}\left(h_i-\sqrt{|x_{ia}-x_{ja}|}\right)$$

with $0 < h_i < 1$.

In our AVEBE example, we assume that $h_i = 0.1$ for all actors. It means that actors start to select the least powerful actors if the square root of the difference of their policy positions is larger than 10 percent of the position range on the issue.

We illustrate the CA and PA specifications with the AVEBE issue on the environmental investment. As we have seen above, all actors make an access request to the Committee Goudswaard at time $t = 1$. The Committee Goudswaard has to accept six requests (five from other actors; see Section 5.1). In the CA specification, these requests are ordered on the basis of the resources of the actors. Since we deleted the RABO Bank and the National Investment Bank (no position), Table 1 shows that the Committee will accept the requests of the CDA, Green Movement, the Ministry of Agriculture, the Farmers, and one randomly chosen actor from those with resources 0.18. In the PA specification, the Ministries of Economic Affairs and Finance will first be selected, followed by the AVEBE's Executive and Supervisory Boards. Finally either the Second Chamber or the Second Chamber Committee for Agriculture will be selected.

5.3.3. Two Alternative Estimates for the Likelihood of Success

We now return to the actor's estimate of the likelihood that an access request will be accepted. Under the CA and CPA specifications, actors realize that the likelihood of acceptance of their access requests depends on their relative amount of resources. Requests of actors with large resources are more likely to be accepted. Moreover, actors also realize that actors with large resources will probably be attractive targets for many actors in the policy network. Accordingly, powerful actors will have to refuse more access requests than less powerful actors. Under the PA, CPA, and PLA specifications, actors realize that the likelihood of acceptance of their access requests depends on the proximity of their own policy positions to those of the target actors. We therefore formulate two simple alternative estimates actors make for the likelihood of success. The first estimate is based on a comparison of his resources with those of the target actor, the second on a comparison of their policy positions. In the first estimate, denoted *Control Likelihood specification* (CL), actor i estimates the likelihood of acceptance of an access request by actor j at time $t = 0$, p^0_{ij}, as follows:[9]

$$r_i - r_j \geq 0 \rightarrow p^0_{ij} = 1;$$
$$-.9 < r_i - r_j < 0 \rightarrow p^0_{ij} = 0.1[10(r_j - r_i)];$$
$$r_i - r_j \leq -.9 \rightarrow p^0_{ij} = 0.1.$$

In the second, denoted *Policy Likelihood specification* (PL), actors compare their own policy positions with those of the target actors. Actor i estimates the likelihood of acceptance of an access request by actor j at time $t = 0$, p^0_{ij}, as follows:

$$p^0_{ij} = 0.1\left[10\left(\sum_{a=1}^{m}\sqrt{|x_{ia} - x_{ja}|}\right)\right];$$
$$\sum_{a=1}^{m}\sqrt{|x_{ia} - x_{ja}|} < 0.1 \rightarrow p^0_{ij} = 0.1.$$

In both models, we assume that actors are able to learn through experience. If an access request of actor i to actor j is not accepted by actor j, actor i will reduce p_{ij} in subsequent iterations by 0.1 until p_{ij} reaches its lowerbound of 0.1.

5.3.4. Summary of Substantively Interesting Models

The two access request specifications, the four access acceptance specifications, and the two alternative estimates for the likelihood of success result in sixteen possible access models. Two of them, the base models, are completely opposite to one another. The *Control Maximization Model* (CMM) is based on the specifications CR, CL, and CA. The *Policy Maximization Model* (PMM) is based on the specifications PR, PL, and PA. In between the two base models we find the *Control/Policy interaction Model* (CPM) in which the specifications PR, CL, and CPA are combined. Even more extreme than the PMM is the *Policy/Legitimation Model* (PLM) in which the specifications PR, PL, and PLA are combined. These two interaction models are also theoretically interesting.

Figures 2(a)–(e) and 3(a)–(e) illustrate how the access relations evolve in the AVEBE policy domain for the two base models. These illustrations are based on *one* simulation run for *all three issues* simultaneously. The simulation consists of five iterations. Each iteration consists of two steps. In the first step, actors make access requests to other actors. In the second step some of these requests are accepted, others rejected. The resulting access relations induce an influence process through which actors adapt their policy positions. On its turn, the latter induce another expected outcome. The resulting access relations also effect the power of the actors, their estimates of likelihood of success of future requests, and the number of requests actors are allowed to make and have to accept. In the next iteration, actors

[9]See note 8.

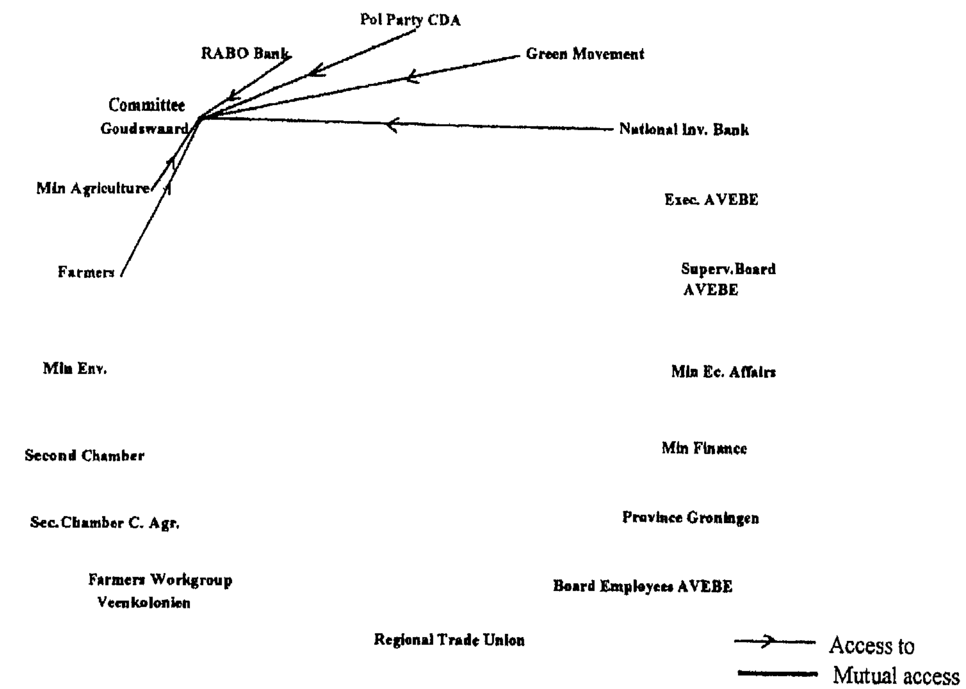

FIGURE 2. Control Maximation Model: (a) Network after one iteration.

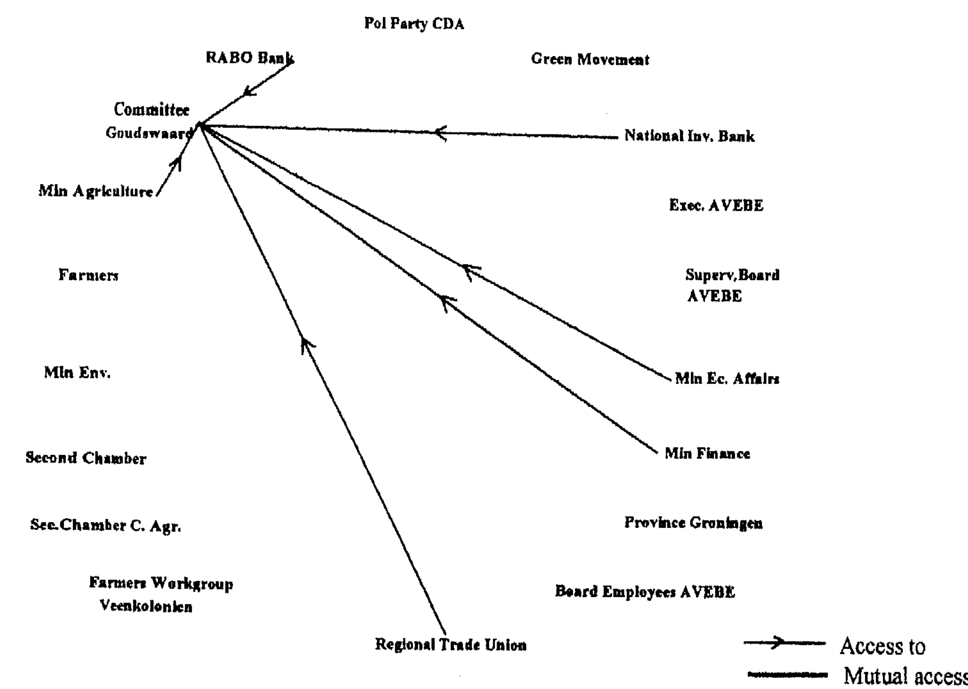

FIGURE 3. Policy Maximization Model: (a) Network after one iteration.

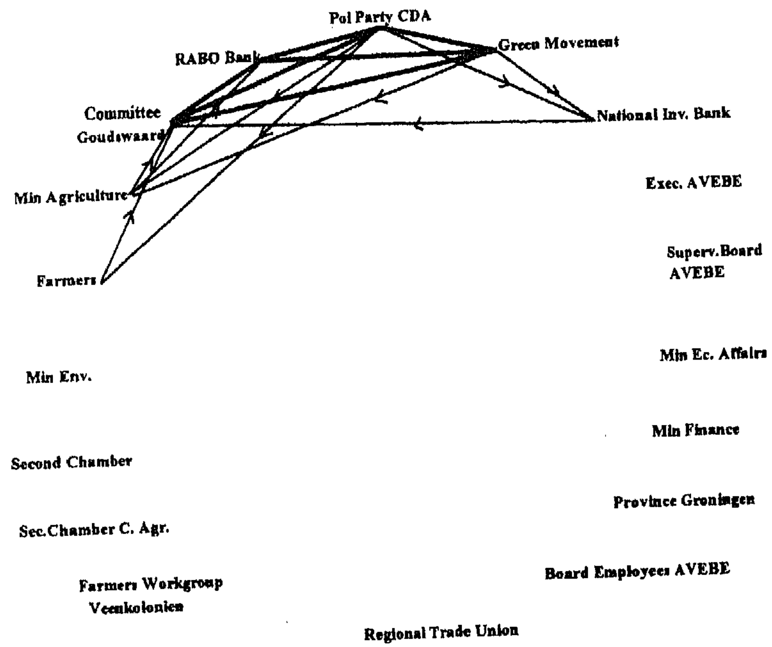

FIGURE 2. *(Continued.)* (b) Network after two iterations.

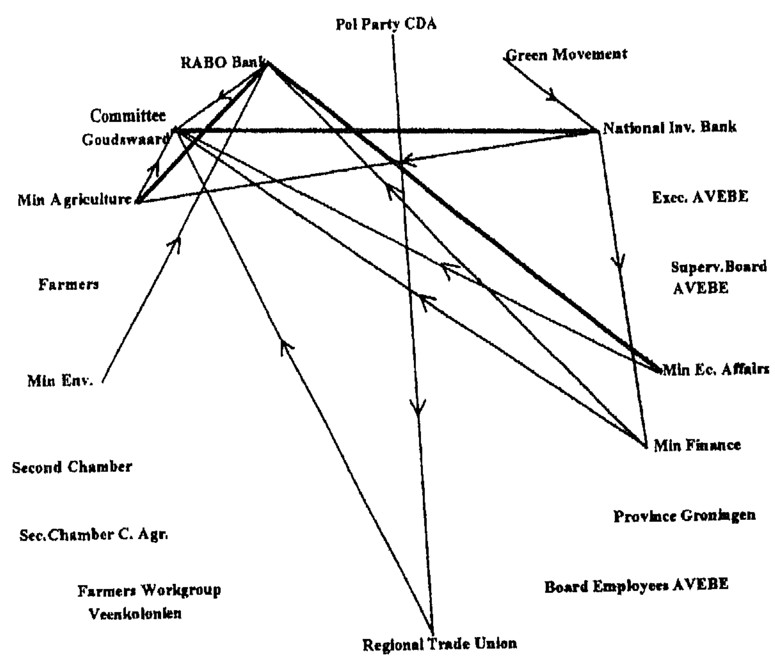

FIGURE 3. *(Continued.)* (b) Network after two iterations.

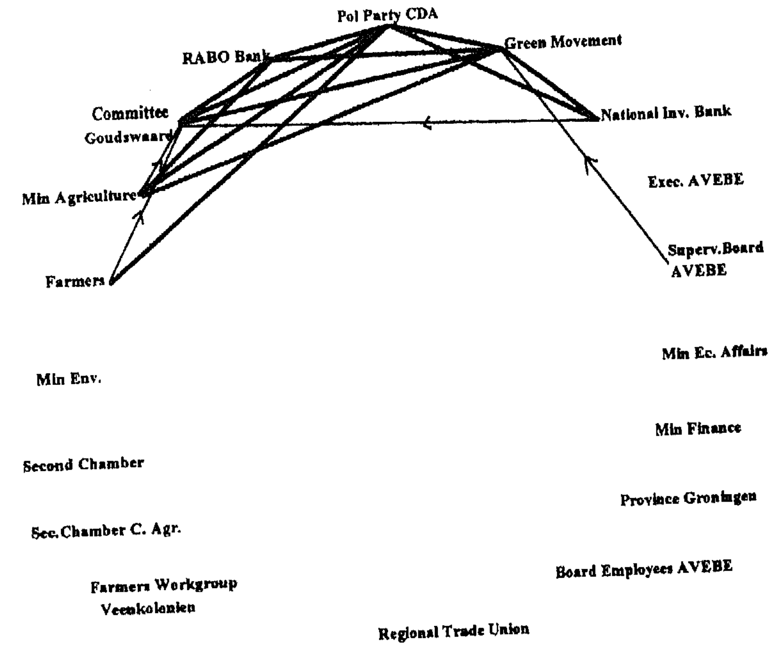

FIGURE 2. *(Continued.)* (c) Network after three iterations.

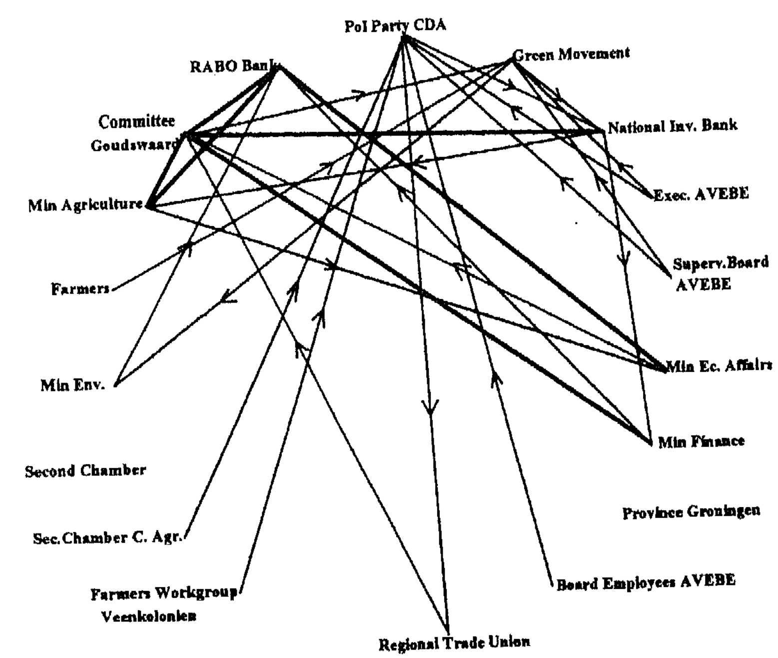

FIGURE 3. *(Continued.)* (c) Network after three iterations.

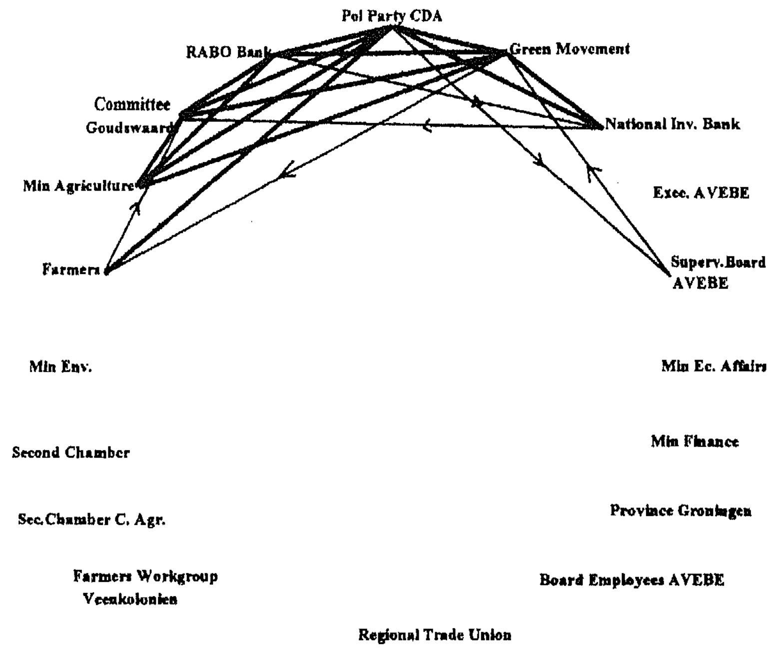

FIGURE 2. (*Continued.*) (d) Network after four iterations.

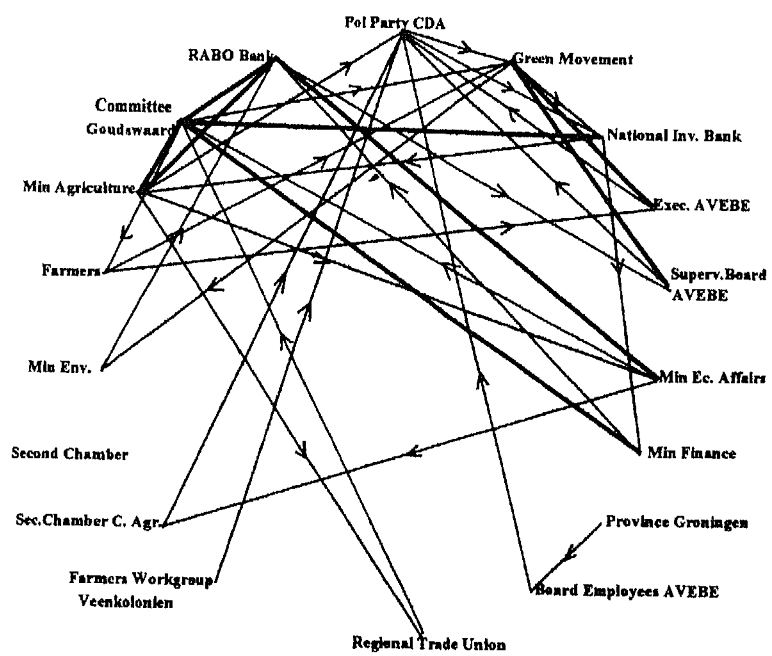

FIGURE 3. (*Continued.*) (d) Network after four iterations.

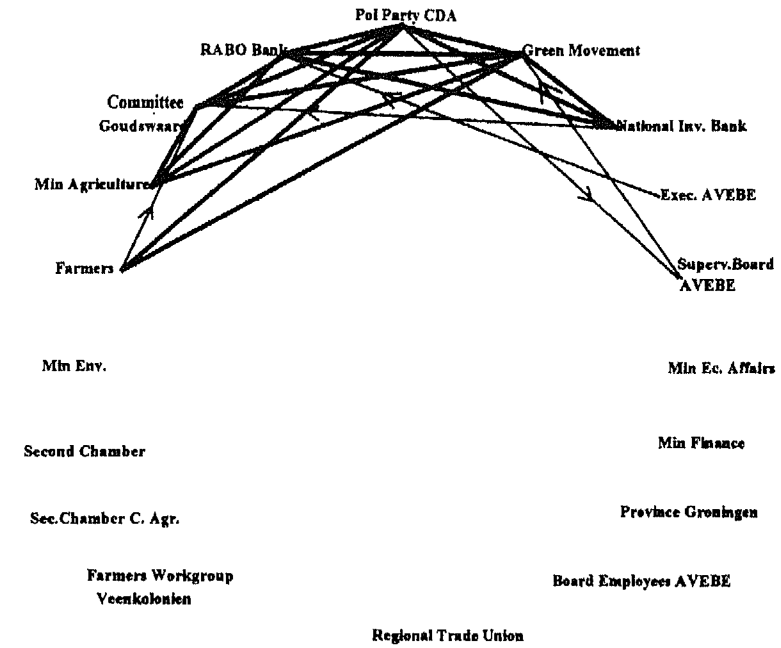

FIGURE 2. (*Continued.*) (e) Network after five iterations.

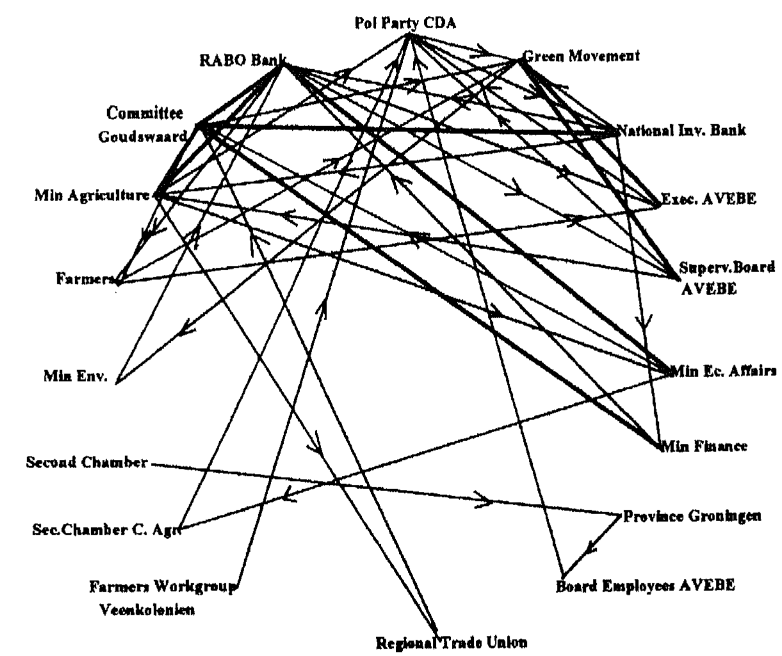

FIGURE 3. (*Continued.*) (e) Network after five iterations.

again make access requests based on the results of the previous iteration. New access relations may appear while others may disappear.

The figures show that at time $t = 1$ only the Committee Goudswaard is chosen as at time $t=0$ no access relationships exist. At time $t = 1$, several access relations have been created. From that moment on, the successful private actors become potential targets for other actors, as they have positive control over other actors. In this way the number of relationships in the network, and the number of actors with access relations to other actors, gradually increase.

Figures 2 and 3 show that the two base models give rise to fundamentally different access networks. Figure 2 shows that the Control Maximization Model results in a dense network among the few happy actors with many resources, excluding most actors in the domain from any influence at all. Figure 3 shows that, in sharp contrast with the CMM, the Policy Maximization Model results in a rich network in which all actors in the policy domain are involved. As random choices are made in the process, we will not make further substantive inferences on the basis of this single simulation, but on 100 repetitions. Each of these simulations consists of five iterations. The latter is based on experimentation with artifical data.

6. MODEL COMPARISON

In this Section we systematically compare predicted decision outcomes and the network structure resulting from the different models.

Table 3 contains the predicted outcomes of all sixteen possible combinations of the three specifications. The table shows that each of the components has a significant effect on the predicted outcomes. This is confirmed in an analysis of variance. The three components and their interactions explain a little more than 60 percent of the variance for environmental investments and debt reduction. For own capital the explained variance is 45 percent. The analysis of variance also shows that all two-way interactions and the three-way interaction are highly significant. The two substantively interesting PMM and PLM models give the most deviating predictions. Without any question, the Policy Maximization Model gives the best predictions on environmental investments and debt reduction. All models give too high predictions for own capital with best scores for PMM and PLM.[10] This is the first indication that the policy driven models do much better than those driven by control.

The second indication in favor of the policy driven models lies in the structure of the networks generated. Again, we systematically compare all combinations of the three specifications, now with regard to the networks they generate. First, we consider the densities of the networks under the different specifications in Table 4. If we examine the mean densities over 100 simulations, only the PLA specifica-

[10] If we use the empirical network between the actors and apply the Stokman and Van den Bos Two-Stage Model on that network, the following predictions are obtained: 35 percent for own capital, MDf 182 for dept reduction and MDf 73 for investments environment. This means that the PMM model, without using any information from the empirical network, does not result in fundamentally worse predictions than the Two-Stage model.

TABLE 3
Decision Outcomes in AVEBE Policy Domain (100 Simulations per Condition)*

Issue		Decision Outcomes Mean Values (sd in brackets)			
		Acceptance Specification			
Likelihood Specification	Request Specification	CA	CPA	PA	PLA
Investments environment (Actual outcome: 73 MDl)					
CL	CR	**96.3(2.9)**	96.7(2.1)	94.1(2.3)	88.0(2.3)
	PR	94.1(3.2)	**96.3(2.4)**	81.9(4.5)	91.6(3.7)
PL	CR	95.1(3.1)	90.0(2.9)	80.3(3.4)	89.5(2.2)
	PR	92.7(3.0)	90.2(2.5)	**77.2(2.1)**	**82.2(2.2)**
Debt Reduction (Actual outcome: 183 MDl)					
CL	CR	**190.9(2.5)**	196.3(3.0)	187.2(2.0)	187.4(2.7)
	PR	203.5(5.7)	**196.6(4.3)**	179.1(3.3)	191.8(5.4)
PL	CR	187.2(3.4)	185.7(2.1)	180.4(2.0)	178.0(1.9)
	PR	193.8(2.3)	181.2(3.2)	**179.3(3.8)**	**172.5(4.5)**
Own Capital (Actual outcome: 20 Percent of Total Capital)					
CL	CR	**35.8(0.5)**	35.6(0.7)	37.2(0.4)	35.1(0.6)
	PR	35.8(0.4)	**35.4(0.7)**	35.5(1.0)	34.2(0.6)
PL	CR	35.7(0.6)	35.8(0.4)	35.6(0.4)	33.5(0.3)
	PR	35.5(0.4)	35.9(0.5)	**34.5(0.7)**	**34.4(0.5)**

***bold:** theoretically interesting models (CMM, CPM, PMM, and PLM from left to right)

TABLE 4
Densities of Generated Networks in AVEBE Policy Domain (100 Simulations per Condition)*

Issue		Densities			
		Acceptance Specification			
Likelihood Specification	Request Specification	CA	CPA	PA	PLA
(A) Mean Values Over 100 Simulations (sd in brackets)					
CL	CR	**0.11(0.000)**	0.13(0.002)	0.09(0.002)	0.15(0.002)
	PR	0.11(0.000)	**0.13(0.007)**	0.12(0.006)	0.15(0.006)
PL	CR	0.12(0.000)	0.13(0.001)	0.12(0.003)	0.15(0.002)
	PR	0.14(0.005)	0.13(0.004)	**0.12(0.009)**	**0.15(0.005)**
(B) Density Aggregated Network (density empirical network: 0.50)					
CL	CR	**0.12**	0.16	0.19	0.24
	PR	0.29	**0.25**	0.33	0.63
PL	CR	0.13	0.16	0.27	0.27
	PR	0.30	0.25	**0.40**	**0.51**

***bold:** theoretically interesting models (CMM, CPM, PMM, and PLM from left to right) tion results in fundamentally higher densities (.15 against .11 to .13 for the others). Also, some interaction effects can be seen. The poorest network is generated by the combination of CL, CR, and PA. Another important finding is the larger standard deviation of the densities under PR. For the standard deviations we find even higher interaction effects than for the mean densities themselves. These interaction effects result in the highest standard deviation for the Policy Maximization Model and the lack of variation in the Control Maximization Model.

Since density is a highly aggregated property of networks, many different networks of equal density can be generated. For that reason, it is interesting to look at the aggregated network over all 100 simulations. Part B of Table 4 contains the densities for these aggregated networks. Fundamental differences become apparent for the different combinations. At the aggregated level, the densities vary between a low .12 for the CMM to more than .50 for some models with PLA. The two strongly policy driven models PMM and PLM generate networks with high densities of .40 resp. .51, of the same order as the density in the empirical network. Only one other network has a higher density. This implies that many relations are not generated in all simulations and that certain relations are more likely than others. In general, the policy driven models result in very rich networks. Tables 5 and 6 show the fundamental differences of the network structures in the control and policy driven models. Table 5 shows the mean control values among the actors under CMM, Table 6 under PMM. Table 5 shows that the different simulations generate almost identical networks. Most actors in the policy domain do not succeed to influence other actors and the outcome. The model does not generate the central place for the Committee Goudswaard as the final influence target. In sharp contrast to this, Table 6 shows that the PMM model generates many different networks. All actors can influence other actors in at least some simulations. The model generates a network in which the Committee Goudswaard both is the actor with the most control over other actors and the target for most actors. If we compare the aggregated network under PMM with the empirical network (Table 7), the PMM network is more hierarchical than the empirical one. PMM generates insufficient access relations among actors with moderate control to other actors.[11] The overall control of the actors is very well reproduced, however. This all provides again strong evidence for the policy driven models. Of the four theoretically interesting models, PMM and PLM by far outperform the two others. PMM seems to do a little better than PLM, but further empirical applications are required to make a fundamental choice between them.

In our models actors do not aim at reciprocal relations, although some researchers claim that actors generally do so (Doreian et al., 1996). Nevertheless, most relations under both models are reciprocal. Here we again demonstrate that reciprocity may not be the underlying process but a side effect of other processes, like Leenders showed for friendship choices in class rooms (Leenders, 1996).

[11]The hierarchical structure of networks can be compared with Snijders' coefficient for heterogeneity H (Snijders, 1981). For our comparison we use H under the null model of uniform distribution of the lines given the number of points and degree sum (density). $H = .50$ for PMM (Table 6) and $H = .20$ for the empirical network (Table 7).

TABLE 5
Aggregated Control Matrix (Control Maximization Model) AVEBE Policy Domain

	CDA	Green	RABO	Goud.	M.Agr.	N.I.B.	Farm	SBAV.	Ex.AV.	Veenk	M.E.A.	M.Fin.	S.Ch.	C.Agr.	M.Env.	Pr.Gr.	Em.AV.	Tr.Un.	**Control**
Pol. Party CDA	***0.25***	***0.24***	***0.26***	***0.25***	***0.29***	***0.36***	***0.50***	**0.53**	*0.31*										2.74
Green Movement	***0.20***	***0.19***	***0.20***	***0.20***	***0.23***	***0.29***	***0.40***												1.53
RABO Bank	***0.19***	***0.18***	***0.19***	***0.19***	***0.22***	***0.27***													0.62
Com. Goudswaard	***0.15***	***0.15***	***0.15***	***0.15***	***0.17***														0.34
Min. Agriculture	***0.09***	***0.08***	***0.09***	***0.09***	***0.10***														0.24
Nat. Inv. Bank	***0.06***	***0.06***	***0.06***	***0.06***		***0.09***													0.15
Farmers	***0.05***	***0.05***		***0.05***			***0.10***												0.06
Superv. B. AVEBE		**0.03**	**0.03**					***0.47***											0.04
Exec. AVEBE		*0.02*	*0.02*						***0.69***										0.00
Veenkolonien										***1.00***									0.00
Min. Ec. Affairs											***1.00***								0.00
Min. Finance												***1.00***							0.00
Sec. Chamber													***1.00***						0.00
Sec. Ch. Com. Agr.														***1.00***					0.00
Min. Environment															***1.00***				0.00
Prov. Groningen																***1.00***			0.00
Emplees AVEBE																	***1.00***		0.00
Reg. Trade Union																		***1.00***	0.00

Bold plus italic: access relation in more than 75% of simulations
Bold: 50–74% of simulations
Italic: 25–49%
Regular: 1–25%
Blank: no relation

TABLE 6
Aggregated Control Matrix (Policy Maximization Model) AVEBE Policy Domain

	Goud.	CDA	RABO	M.Agr.	N.I.B.	SBAV.	Ex.AV.	M.Env.	Green	M.Fin.	M.E.A.	Farm	S.Ch.	C.Agr.	Em.AV.	Pr.Gr.	Tr.Un.	Veenk	**Control**
Com. Goudswaard	***0.27***	***0.20***	**0.15**	*0.25*	0.02	***0.29***	**0.28**	***0.41***	*0.05*	**0.39**	**0.40**	*0.20*	***0.85***	***0.86***	*0.34*	0.01			4.66
Pol. Party CDA		*0.33*	**0.18**	*0.37*	*0.21*	**0.40**	**0.37**	0.12	*0.33*	*0.22*	*0.22*	0.14				0.02	0.14		2.71
RABO Bank	**0.15**	**0.12**	*0.46*	**0.22**	0.11	0.11	0.12	*0.19*	*0.11*	0.19	*0.21*	0.02	0.04	0.03	0.10	0.05	0.07		1.83
Min. Agriculture	0.15	0.02	**0.07**	*0.14*	0.01	0.03	0.04	*0.09*	**0.07**	0.08	0.05	0.03			0.04	0.02	0.02		0.72
Nat. Inv. Bank	*0.05*	*0.03*	*0.04*	*0.03*	***0.53***	0.02	0.01		0.02		0.01				0.06				0.28
Superv. B. AVEBE	**0.06**	*0.05*	0.01			***0.15***	0.01										0.12		0.24
Exec. AVEBE	**0.05**	*0.05*	0.01				***0.17***		0.01								0.11		0.22
Min. Environment	0.08		*0.03*		*0.06*			***0.16***	0.02						0.02				0.22
Green Movement		**0.15**	0.03						***0.37***										0.18
Min. Finance	0.05		*0.01*		0.01		0.01	0.02	0.01	***0.12***		0.02							0.13
Min. Ec. Affairs	0.05		*0.02*		0.01			0.02	0.01		***0.12***								0.12
Farmers		**0.04**										***0.60***							0.04
Sec. Chamber	0.04												***0.12***						0.04
Sec. Ch. Com. Agr.	0.04													***0.12***					0.04
Emplees AVEBE		*0.01*			*0.02*										***0.43***				0.03
Prov. Groningen		*0.01*							*0.01*							***0.90***			0.02
Reg. Trade Union	*0.01*																***0.55***		0.01
Veenkolonien		0.00							0.002									***1.00***	0.02

Bold plus italic: access relation in more than 75% of simulations
Bold: 50–74% of simulations
Italic: 25–49%
Regular: 1–25%
Blank: no access

TABLE 7
Empirical Control Matrix AVEBE Policy Domain

	CDA	M.Ag.	Goud.	Green	RABO	Ex.AV.	SBAV.	Farm	N.I.B.	Pr.Gr.	M.Env.	M.E.A.	M.Fin.	S.Ch.	C.Agr.	Em.AV.	Veenk	Tr.Un.	**Control**
Pol. Party CDA	**0.28**	0.20	0.34		0.34	0.21	0.23		0.30			0.37	0.38				0.35		2.99
Min. Agriculture	0.10	**0.07**	0.11	0.17	0.12	0.07	0.08	0.13	0.10	0.11	0.20	0.13	0.13	0.33	0.29	0.14	0.12	0.28	2.68
Com. Goudswaard	0.17	0.12	**0.20**			0.13	0.14		0.18	0.20		0.22	0.23			0.25		0.49	2.32
Green Movement		0.16		**0.39**		0.17	0.18	0.30		0.27	0.47					0.33	0.04		2.31
RABO Bank	0.21	0.15			**0.26**	0.16	0.17	0.29	0.22								0.27		1.72
Exec. AVEBE	0.05	0.04	0.06	0.09	0.06	**0.04**	0.04	0.07	0.05	0.06				0.18	0.16	0.07	0.06	0.15	1.18
Superv. B. AVEBE	0.05	0.04	0.06	0.09	0.06	0.04	**0.04**	0.07		0.06				0.18	0.16	0.07	0.06		0.98
Farmers		0.04		0.10	0.07	0.04	0.05	**0.08**		0.07					0.17				0.61
Nat.Inv.Bank	0.07	0.05	0.08		0.08	0.05			**0.07**			0.09	0.09						0.58
Prov. Groningen		0.02	0.03	0.05		0.02	0.02	0.04		**0.03**	0.06	0.04		0.10	0.09	0.04	0.02		0.56
Min. Environment		0.04		0.09						0.06	**0.11**	0.07	0.07				0.06		0.49
Min. Ec. Affairs	0.03	0.02	0.04						0.04	0.04	0.07	**0.04**	0.05						0.34
Min. Finance	0.03	0.02	0.04						0.04		0.07	0.04	**0.05**						0.30
Sec. Chamber		0.02				0.02	0.02			0.03				**0.08**	0.07	0.03			0.26
Sec. Ch. Com. Agr.		0.02				0.02	0.02	0.03		0.03				0.08	**0.07**				0.25
Emplees AVEBE		0.01	0.02	0.03		0.01	0.01			0.02				0.06		**0.02**		0.05	0.24
Veenkolonien	0.01	0.01			0.01	0.01	0.01			0.01	0.02					0.02	**0.01**		0.12
Reg. Trade Union		0.01	0.01			0.01										0.02		**0.03**	0.08

Blank: no relation

7. CONCLUSIONS AND FURTHER EVIDENCE

In policy networks actors use access relations to influence other actors. Establishment and shifts of access relations and their consequences for outcomes of decisions were the main focus of our paper. In our computer simulation models, we explicitly represented the fundamental difference between voting and influencing. Moreover, due to incomplete information and simultaneous actions by other actors, actors used rough heuristics and learned from experience.

The alternative models in this paper differ from one another in only three components. The first is the actor's estimate of the utility of access requests. The second is the actor's estimate of likelihood of acceptance by other actors. The product of the two determines the expected utility of alternative access requests for an actor and consequently the order in which he makes these requests. The third component is the actual order in which actors accept requests from other actors.

We devised two base models that correspond to two basic views of politics. In the first view politics is seen as power driven. The *Control Maximization Model* corresponds to this view. Actors aim at access relations with the most powerful actors in the field. Moreover, they estimate their likelihood of success by comparing their own resources with those of the target actors. Power also determines the order in which actors accept requests. In the second view, policy matters. In the *Policy Maximization Model*, actors roughly estimate the effects access relations might have on the outcome of decisions. Actors select requests to "bolster" their own preference as much as possible, but they realize that other actors do the same. In addition, we formulated two models with interaction effects between power and policy motives.

We showed that the alternative models result in fundamentally different network structures and predicted outcomes. Moreover, we demonstrated that the policy driven models do fundamentally better than the power driven models. The policy driven models generated a larger variety of networks and resulted in better predictions of the outcomes of decisions. This implies that the following view on politics is strongly substantiated by the simulation results in this paper.

Trying to establish influence relations with other actors in policy networks, actors are confronted with two counteracting forces. On the one hand they realize that powerful actors with distant and opposite views are most attractive as target. If successful, such a relation will greatly effect the outcomes of decisions. On the other hand, actors realize that these actors are less likely to accept access requests than more proximate actors. Actors realize that other actors act like they do, giving high priority to influence from like-minded other actors. Only if such actors are not present, they are willing to accept influence from more distant actors. Actors therefore select influence purposively to "bolster" their own position. This prevents them from changing their own preferences while trying to influence other actors to do so. This bolstering effect might be so strong that actors go beyond the point of simply selecting the most proximate actors. Within a certain threshold around their own position, actors select the most powerful ones, but beyond that threshold the least powerful ones. The results of this rather extreme *Policy/Legitimation Model* came close to those of the simpler policy driven base model. At the network level both models generated many ties between like-minded actors and networks in which all actors were involved in the influence process.

In this paper only one application in a policy domain with three decisions could be considered. Stokman and Berveling (1996) provide further evidence for the policy driven models. They apply and compare the substantively interesting models on two policy domains in Amsterdam (Berveling, 1994). The data were collected by interviewing representatives of all involved actors (depending on the issue, 50 to 100 actors). The analysis concerned six decisions in the urban development field and four decisions in the domain of minority problems. The two policy driven models gave systematically better predictions of outcomes on all issues. For both models, nine out of ten predictions could be classified as correct. We also found similar differences between the aggregated networks of the two base models. Again, the control base model generated very poor networks against much richer networks for the policy driven base model.

Notwithstanding the promising results for the policy driven models, further research is required. Although the policy driven models give good predictions of issue outcomes, they do not yet generate networks that are sufficiently similar to empirical networks. A next step could be to estimate essential parameters in the simulation models by a fitting procedure of certain empirical network characteristics. This strategy is suggested in Snijders (1996), but his statistical model has to be extended for this purpose. This would provide us also with statistically sound goodness of fit criteria.

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